



PATENT

Date of Notice of  
Allowance 5-09-2003

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WAW  
# 11/D  
A

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

2-5-04

In Art Unit 1742

Examiner: Daniel J. Jenkins

Applicants:

Morris F. Dilmore et al

Serial No:

10/039,811

Filed:

January 8, 2002

For:

METAL CONSOLIDATION PROCESS  
APPLICABLE TO FUNCTIONALLY  
GRADIENT MATERIAL (FGM)  
COMPOSITIONS OF TANTALUM AND  
OTHER MATERIALS

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Pasadena, California  
July 2, 2003

Assistant Commissioner for Patents

Arlington, VA 22313-1450

Attention: Official Draftsman

Sir:

The enclosed formal drawings are transmitted per  
the requirement therefore accompanying the Notice of  
Allowance.

Respectfully submitted,

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WWH:hk  
Enc.  
Docket 12,105-1

In Figs. 9a and 9b, a penetrator 90 has combined cylindrical and tapered shape (as at sections 90a and 90b as shown), and is a solid body. Section 90b tapers toward tip 91. The penetrator is formed by the method of the invention, i.e. is a consolidated body, and has FGM property (increasing strength and/or ductility in axial length direction 93; and FGM property (decreasing strength and/or ductility) in center-to-side directions 94. Those directions are indicated by arrows as shown. Thus, the tip 91 and tapered wall 96 are stronger than the base 98; and body outer side 99 is stronger than body center 100'.

1 property (decreasing strength and/or ductility) in  
2 axial length direction 87; and FGM property (decreasing  
3 hardness and/or toughness) in wall thickness direction  
4 88, those directions indicated by arrows, as shown.  
5 Thus, the outer side is more ductile than the inner  
6 side, and the nose 82 is more ductile than the base 81.

7 In Figs. 9a and 9b, a penetrator 90 has  
8 combined cylindrical and tapered shape (as at sections  
9 90a and 90b as shown), and is a solid body. Section  
10 90b tapers toward tip 91. The penetrator is formed by  
11 the method of the invention, i.e. is a consolidated  
12 body, and has FGM property (increasing strength and/or  
13 ductility in axial length direction 93; and FGM  
14 property (decreasing strength and/or ductility) in  
15 center-to-side directions 94. Those directions are  
16 indicated by arrows as shown. Thus, the tip 91 and  
17 tapered wall 96 are stronger than the base 98; and body  
18 outer side 99 is stronger than body center 100. ✓

19 In Figs. 10a and 10b, an EFP body 110 is  
20 shown in side and bottom views. A body hollow 111 is  
21 formed below a domed top 112.

22 In each of Figs. 8a, 8b, 9a, 9b, 10a, and  
23 10b, the body at its toughest zone may consist of  
24 tantalum, and at less tough zone may consist of  
25 tantalum complexed with metal or metals selected from  
26 the above HGM group.



10/039,811

1-5

FIG. 1.

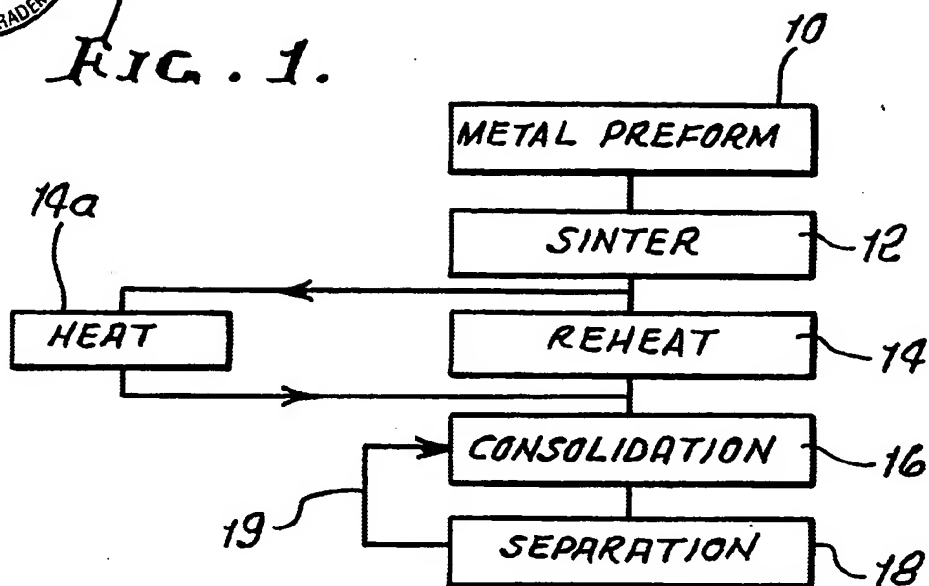
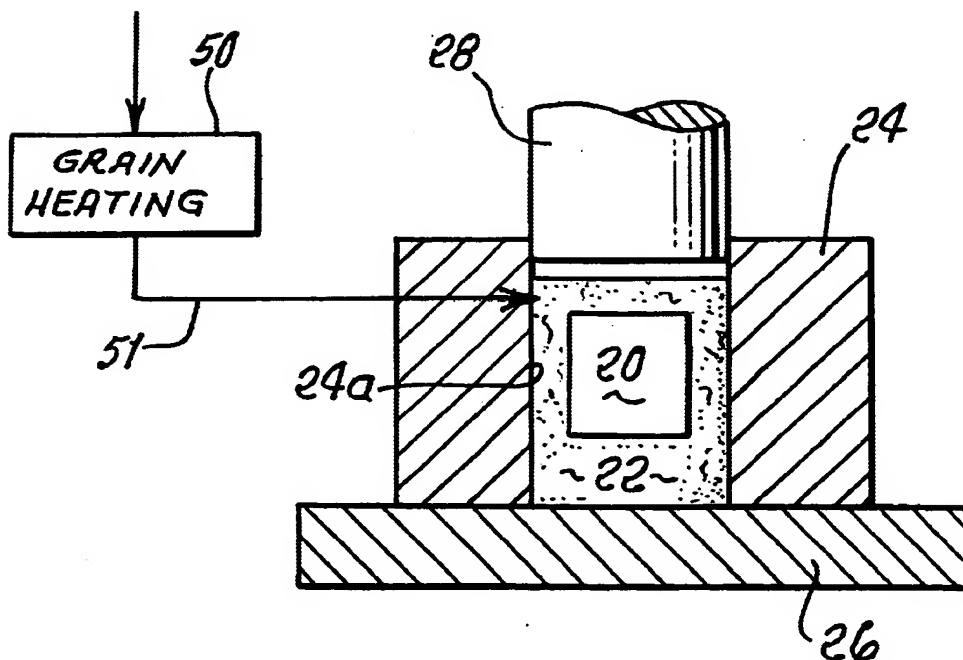


FIG. 2.





2-5

FIG. 3.

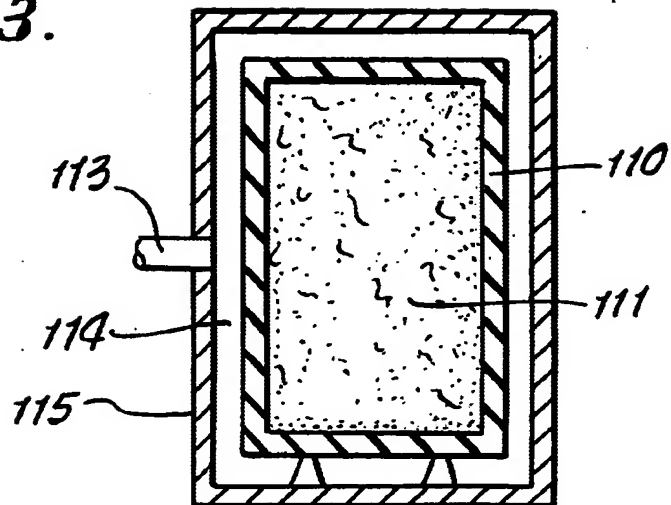
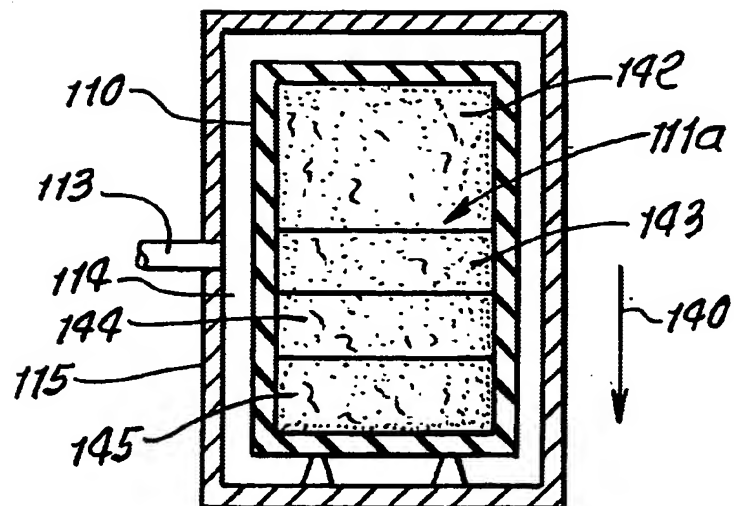


FIG. 4.





3-5

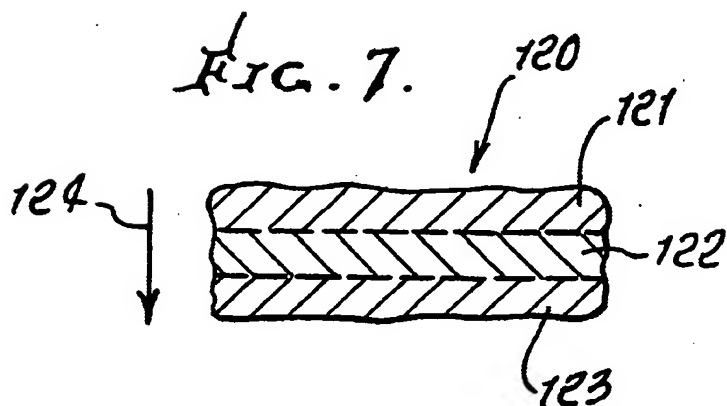
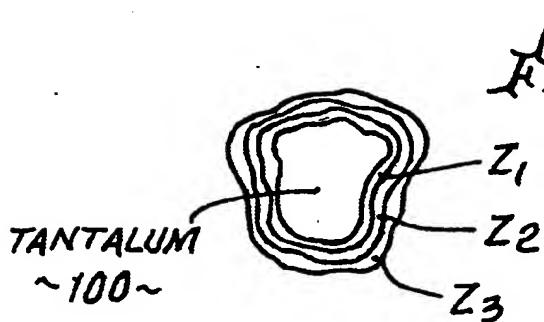
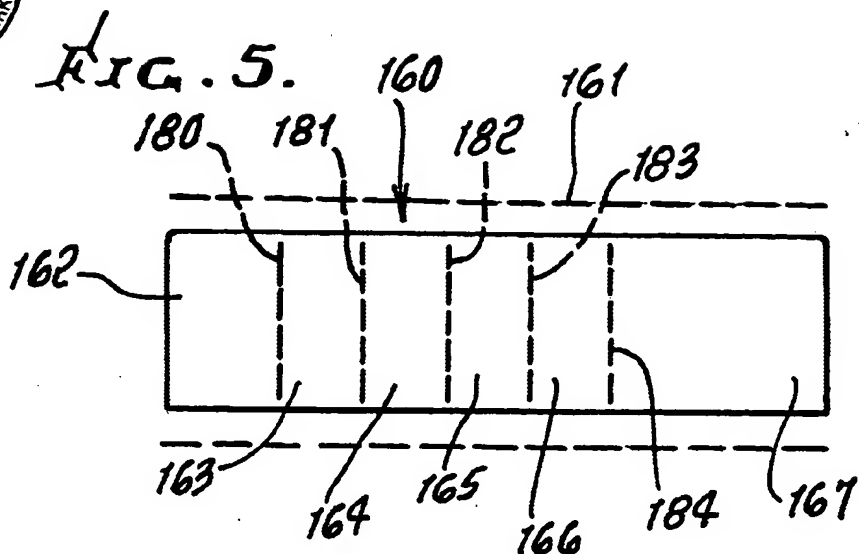


FIG. 8a.

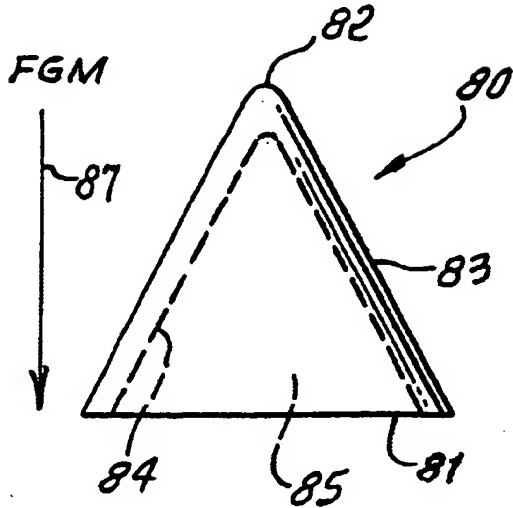


FIG. 8b.

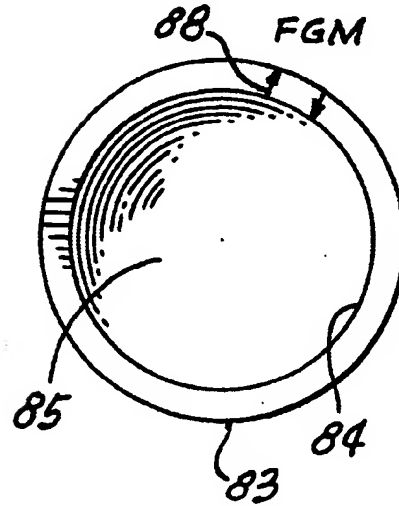


FIG. 9a.

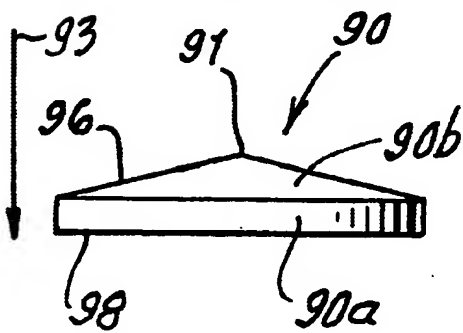
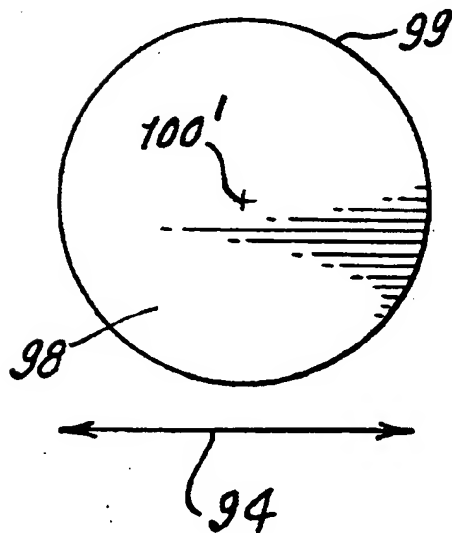


FIG. 9b.





5-5

FIG. 10a.

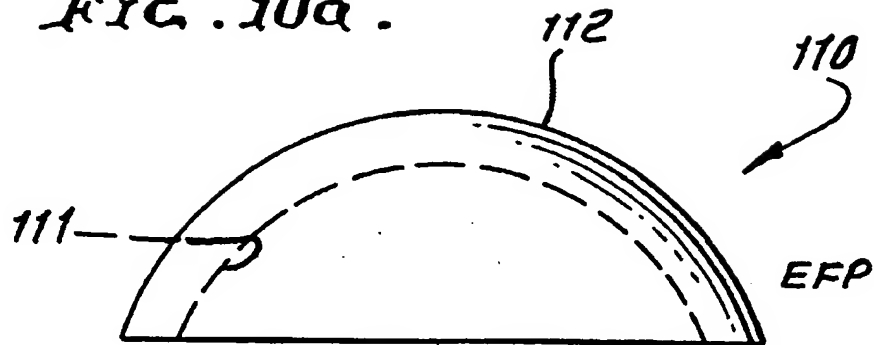


FIG. 10b.

